Preprint
UCRL-JC-140641

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This article was submitted to
American Rock Mechanics Association, DC Rocks: "Rock Mechanics in the National Interest" the 38th U. S. Rock Mechanics Symposium, Washington, D.C., July 7-10, 2001

U.S. Department of Energy

Lawrence
Livermore
National
Laboratory

September 29, 2000

This work was performed under the auspices of the United States Department of Energy by the University of California, Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.

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A drift-scale distinct element model (DSDE) is being used to analyze geomechanical behavior in the Drift Scale Test (DST) now underway at Yucca Mountain, Nevada. The DST is a large-scale, long-term thermal test designed to investigate coupled thermal-mechanical-hydrological-chemical behavior in a fractured, welded tuff rock mass. Electric heaters are being used to heat a 50 m length of drift for 4 years, followed by 4 years of cooling. The target drift wall temperature is 200°C during much of the heating period. The distinct element method was chosen to permit explicit modeling of fracture deformations. Shear deformations and normal mode opening of fractures are expected to increase fracture permeability and thereby alter thermal-hydrologic behavior in the DST region.

This paper will describe the DSDE model and present preliminary modeling results, including temperature and stress fields, and normal and shear fracture displacements at a series of times after start of heating. Figure 1 shows the drift geometry and associated fracture planes used in the simulations. The fracture locations and orientations were determined by analysis of borehole video logs.

Predicted normal mode fracture deformations are concentrated along and above the heated drift (Figure 2). The results indicate similar magnitudes and spatial distributions of normal deformations at all four times. Some normal mode opening is indicated after 4 years of heating on two subvertical fractures that extend to the edge of the modeled region. This fracture opening is not shown after 8 years, indicating that normal mode opening may be reversible.

Predicted shear fracture deformations shown in Figure 3 are also concentrated above the heated drift, but are generally larger, and the predictions for 4 and 8 years is very similar, indicating that the shear deformation may not be recoverable upon cooling. The predicted fracture deformations are consistent with observed microseismic and acoustic emission activity, which indicate that rock movement is occurring along a few vertical fractures above the heated drift.

a) Drift Geometry for DST

Heated Drift

b) Fractures in Simulated Block

Figure 1. Drift geometry and associated fracture planes for DST simulation. (a) drift geometry for Drift Scale Test. (b) Fracture geometry within simulated block. Note that the drifts shown in (a) are contained within the rockmass shown in (b).

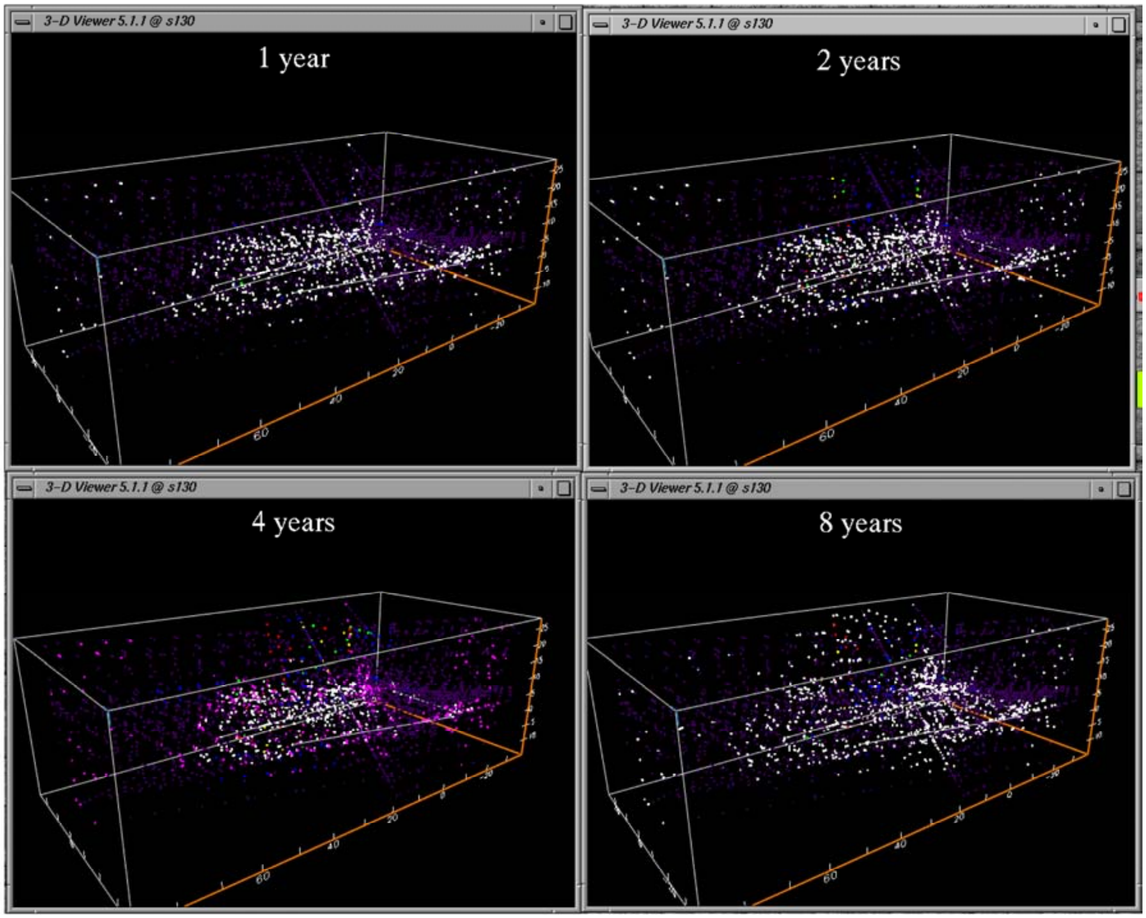

Figure 2. Perspective view of the DST region showing predicted normal mode fracture displacements (colored dots) after 1, 2 and 4 years of heating, and at 8 years, following four years of cooling. Legend is given in Table 1. Faint white lines indicate centerlines of drifts.

Color	Fracture Deformation (mm)
White	< -0.5 (normal closing)
Light Purple	-0.05 - 0.0 (normal closing)
Dark Purple	0.0 – 0.1
Blue	0.1 – 0.5
Green	0.5 – 1
Yellow	1 - 2
Red	>2

Table 1. Legend for fracture displacement plots. Negative values pertain only to normal mode deformations.

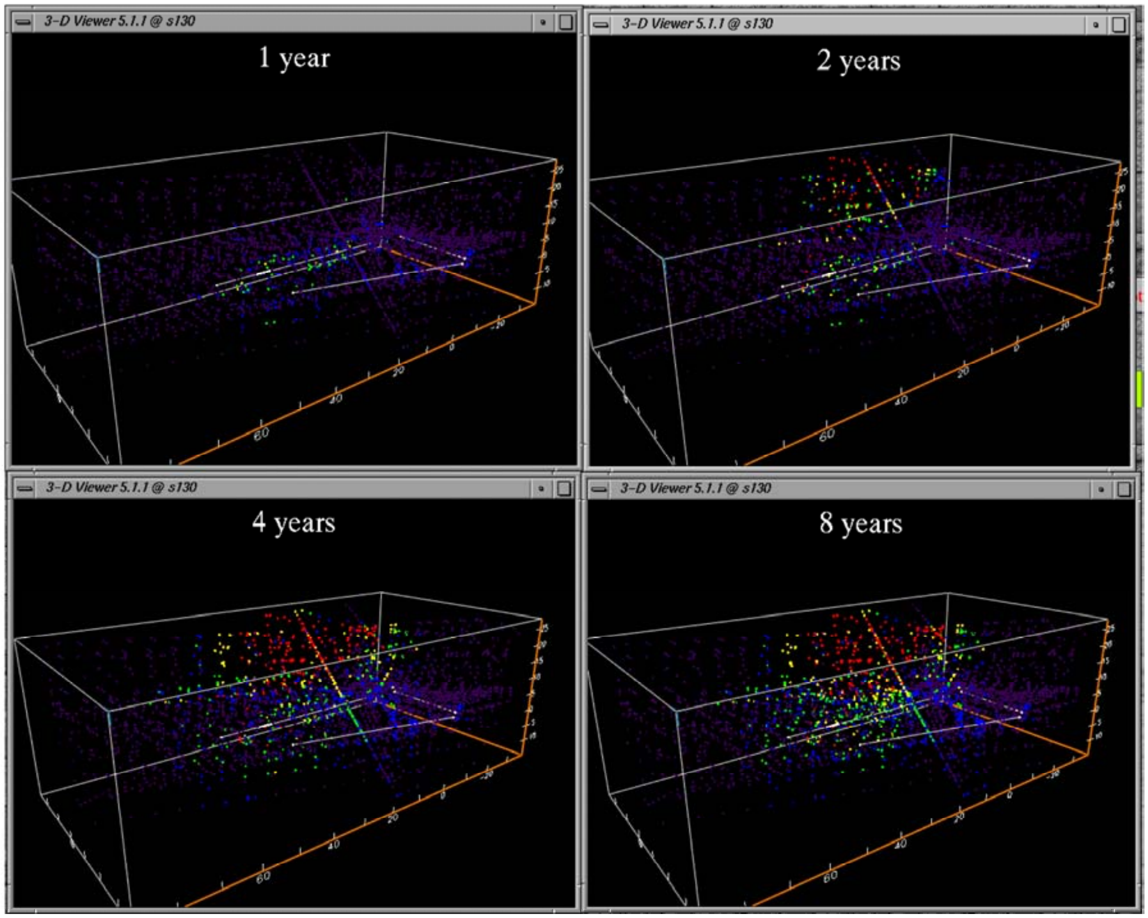

Figure 3. Perspective view of the DST region showing predicted shear fracture displacements (colored dots) at the same times as Figure 2. Legend is given in Table 1. Faint white lines indicate centerlines of drifts.